

**NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF RAILROAD, PIPELINE AND
HAZARDOUS MATERIALS INVESTIGATIONS
WASHINGTON, D.C. 20594**

FACTUAL REPORT

ACCIDENT

Accident Type: Derailment
Date and Time: September 19, 2015 at 6:18 a.m. CDT
Location: Lesterville, South Dakota
Vehicle No: BNSF train GMNXDPK7-17
Fatalities: 0
Injuries: 0
NTSB #: DCA15FR016

TRACK & ENGINEERING GROUP

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Synopsis

On September 19, 2015, about 6:18 a.m. central daylight time, a BNSF freight train G MNXDPK7 17 (a unit ethanol train with 3 locomotives and 98 tank cars) derailed at a small bridge near Lesterville, South Dakota. Seven cars derailed, starting with the second car in the train. Three of the derailed cars released product and caught fire. There were no injuries and no evacuations were necessary. Weather was foggy with poor visibility and approximately 50° F. Estimated damage was \$1.1 million. See figure 1 for an aerial view of the accident site.



Figure 1
Aerial View of Derailment Site

Track Description

The Aberdeen Subdivision Branch Line was originally owned by the Milwaukee Railroad prior to its bankruptcy. This Line was purchased by the BNSF from the state of South Dakota in November 2005. However, the BNSF predecessor had been operating over this line since 1982.¹

The track is designated as the Aberdeen Subdivision Branch Line. It is on the BNSF Twin Cities Division, and at this location it is oriented in a northwest and southeast geographic direction; and in an east to west timetable direction. The entire Aberdeen Subdivision Branch Line is single main track. The milepost (MP) location on this line begins with MP 513.0 (Sioux City, Iowa) and increases numerically as the track continues west to MP 777.0 (Aberdeen, South Dakota). Train GMXDPK7-17 was traveling in the west to east timetable direction. For this report, all compass orientations will be referenced to the timetable direction. Approaching the point of derailment from the west at MP 600.0 to MP 595.0 the track is straight. The following are the grades between MP 600.0 and MP 595.0:

- Between MP 600 and MP 599.6 the grade is ascending 0.1 percent
- Between MP 599.6 and MP 599.1 the track is level
- Between MP 599.1 and MP 598.2 the grade is descending 0.62 percent

¹ The predecessor railroad was the Burlington Northern Railroad (BN). The BN became the BNSF Railway Company (BNSF) when it merged with the Santa Fe Railroad on September 22, 1995.

- Between MP 598.2 and MP 597.8 the grade is descending 0.11 percent
- Between MP 597.8 and MP 597.5 the track is level
- Between MP 597.5 and MP 597.1 the grade is ascending 0.69 percent
- Between MP 597.1 and MP 597.0 the track is level
- Between MP 597.0 and MP 596.8 the grade is descending 0.41 percent
- Between MP 596.8 and MP 596.6 the track is level
- Between MP 596.6 and MP 596.3 the grade is ascending 0.38 percent
- Between MP 596.3 and MP 595.9 the grade is descending 0.25 percent
- Between MP 595.9 and MP 595.7 the track is level
- Between MP 595.7 and MP 595.3 the grade is ascending 0.59 percent
- Between MP 595.3 and MP 595.0 the grade is ascending 0.28 percent

Approximately four trains operate over this track daily that accounts for an annual accumulated gross tonnage of 3.3 million gross tons (MGT). The BNSF said since January 2015, typically one loaded unit ethanol train departs and returns empty weekly over the Aberdeen Subdivision. Occasionally there are two loaded unit ethanol trains operated.² Train GMNXDPK7 17 was a unit train and “key train” with 3 locomotives, 2 buffer cars and a total of 96 loaded tank cars containing denatured fuel ethanol.³ However, the Aberdeen Subdivision Branch Line was not a “key route”. The entire Association of American Railroads (AAR) publication OT-55-O, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*, January 27, 2015 is included in Attachment 3.

The AAR defines a key route as:

A. Definition: Any track with a combination of 10,000 car loads or intermodal portable tank loads of hazardous materials, or a combination of 4,000 car loadings of PIH or TIH (Hazard zone A, B, C, or D), anhydrous ammonia, flammable gas, Class 1.1 or 1.2 explosives, environmentally sensitive chemicals, Spent Nuclear Fuel (SNF), and High Level Radioactive Waste (HLRW) over a period of one year.

B. Requirements:

1. Wayside defective bearing detectors shall be placed at a maximum of 40 miles apart on "Key Routes", or equivalent level of protection may be installed based on improvements in technology.
2. Main Track on "Key Routes" is inspected by rail defect detection and track geometry inspection cars or any equivalent level of inspection no less than two times each year; sidings

² Since the derailment the BNSF no longer operates unit ethanol trains on the Aberdeen Subdivision. They have been re-routed.

³ Definition of “key train” is provided by Association of American Railroads (AAR) publication OT-55-O, *Recommended Railroad Operating Practices for Transportation of Hazardous Materials*, January 27, 2015. “Key trains” have speed restrictions and other operating criteria. According to the BNSF Hazardous Materials Instructions for Rail, a key train includes a train with “A. One (1) or more car loads of Spent Nuclear Fuel (SNF) or High Level Radioactive Waste (HLRW) moving under the following Hazardous Material Response Codes (STCCs) - 4929142, 4929143, 4929144, or 4929147, or B. One (1) or more tank car loads of Poison or Toxic Inhalation Hazard (PIH or TIH) (Hazard Zone A, B, C, or D), anhydrous ammonia (UN1005), or ammonia solutions (UN3318), or C. Twenty (20) or more car loads (including intermodal portable tank loads) of any hazardous material.”

are similarly inspected no less than one time each year; and main track and sidings will have periodic track inspections that will identify cracks or breaks in joint bars.

3. Any track used for meeting and passing "Key Trains" must be Class 2 or higher. If a meet or pass must occur on less than Class 2 track due to an emergency, one of the trains must be stopped before the other train passes.

The maximum authorized speed between MP 548.0 and 600.8 is 25 mph; which requires the BNSF to maintain the track structure to Federal Railroad Administration (FRA) Class 2 track standards. However, there is a speed restriction of 10 mph between MP 587.9 and MP 600.8; which requires the BNSF to maintain the track structure in this area to FRA Class 1 track standards.⁴

Hazardous Materials Regulations 49 CFR 172.820 stipulates additional planning requirements for transportation by rail. However, the additional planning requirements do not become effective until March 31, 2016. By that time, the safety and security risks present must be analyzed for the route and railroad facilities along the route. See attachment 4, for the entire Hazardous Materials Regulations 49 CFR 172.820. In the headings below, a) (4) would have been applicable.

a) *General.* Each rail carrier transporting in commerce one or more of the following materials is subject to the additional safety and security planning requirements of this section:

(1) More than 2,268 kg (5,000 lbs) in a single carload of a Division 1.1, 1.2 or 1.3 explosive;

(2) A quantity of a material poisonous by inhalation in a single bulk packaging;

(3) A highway route-controlled quantity of a Class 7 (radioactive) material, as defined in §173.403 of this subchapter; or

(4) A high-hazard flammable train (HHFT) as defined in §171.8 of this subchapter.

Track Structure Description

The Aberdeen Subdivision Branch Line consists of a mixture of jointed and continuous welded rail of a variety of weights. In the vicinity of the derailment, the track was comprised of jointed 9020 pound rail sections fastened to 8 foot 6 inch wooden crossties with a mix 5 ½ by 9/16 inch and 6 by 5/8 inch track spikes, and 10 inch by 7 inch single shoulder tie plates.⁵ The rail had varying manufacturing dates from 1909 to 1918 and was installed in 1929. The rail also has varying lengths, but the standard length for this rail section is 33 feet long. The joint bars used are referred to a "skirted angle bars". The crossties were last renewed in 2010 and the track was surfaced at the time.⁶ The BNSF anchor pattern for jointed rail is box anchor every second tie for eight rail lengths on each side of railroad crossings and open deck bridges. On tracks with less than 10 MGT, box anchor every fourth tie except at railroad crossings, bridges, and switches. When anchoring rail as specified, if the anchors fall at a rail joint, do not box anchor that tie. Box anchor the tie next to the joint.⁷ The ballast section is crushed granite. The

⁴ Classes of track and operating speed limits are delineated in 49 CFR 213.9 (a).

⁵ A 9020 pound rail section is defined as 90 pounds per three feet of rail.

⁶ Rail installation and crosstie renewal dates were reflected in the *BNSF Track Chart*.

⁷ *BNSF Engineering Instructions 6.4.2 – Anchoring Bolted Rail*. Revision January 1, 2012.

tie cribs appear to be full with an average of 12 inches of shoulder ballast. At the point of derailment (POD) the track was sitting on an average of 26 feet of fill above the ditch line.

Pre-Accident Track Inspection

BNSF visually inspects the track once weekly as required by Federal Track Safety Standards 49 Code of Federal Regulations (CFR) 213.233 (c). The track between the limits of MP 577.0 and MP 602.0 is scheduled to be inspected every Tuesday. However, the BNSF said that inspection schedules can vary based on manpower, projects, and train traffic. The track inspector works alone. The track inspector said that he returns in the opposite direction during the next scheduled inspection, if rail traffic allows. The track inspector said that he inspects the jointed rail at 5 to 7 mph. His last visual track inspection occurred on September 15, 2015, four days before the derailment.

The Roadmaster, the track inspectors' immediate supervisor for the Aberdeen Subdivision, said about two weeks prior to the derailment and a month before that; he and the track inspector inspected track through this area. He said that this area had a 10 mph speed restriction in place when he became the supervisor for this territory. He said that because of the train traffic density and the 10 mph speed, this section of the Aberdeen was on the lower end of his maintenance priorities.

The BNSF conducts track geometry car track evaluations over the Aberdeen Subdivision twice a year. One test is performed with the rail bound geometry car and the other test is done with the STAR car.⁸ The last geometry inspection was conducted with the STAR car on August 8th, 2015. Two tight gage defects were noted in the immediate area of the derailment at MP 596.68 and MP 596.70. The line graph data showed that the tight gage measured 15/16th of an inch tight for 24 feet and 13/16th of an inch for 14 feet respectively; exceeding the FRA allowable limits of ½ inch.⁹ The ½ inch is also the maximum tight gage allowed by the BNSF engineering standards. The rail recovered from this location appeared to show signs of gage face and gage corner rail wear that is typical of curve worn rail or tight gage. The data also showed a gage widening projection (GWP) of 11/16 inch at MP 596.68 which is an indication of future gage widening typically due to tie or fastener conditions. This measurement is not in the *Track Safety Standards*, but is considered a BNSF red tag.

However, BNSF field personnel did not receive the above STAR car defects as red tag defects as they were deleted by the STAR car operator immediately after detection due to a spike in the laser. The deletions of these defects are reflected in the BNSF delete report provided from the STAR car examination vehicle operator. The instrumentation consists of four separate laser devices, two per rail, this system provides a full rail profile and is the primary device for measuring gage.

A previous geometry car track evaluation conducted on the Aberdeen Subdivision was done on the 04/08/2015 with the BNSF #87 car with one defect noted of a tight gage measuring 9/16 inches with a length of 15 feet. See figure 2, for a view of the east end of bridge at MP 596.68, and track taken from the geometry car. The BNSF geometry car data history identifies repeated defects found for prior evaluations. From 9/15/2014 to 9/14/2015 a tight gage repeat defect was recognized at MP 596.67 the defect was 0.58 inches for 15 feet.

⁸ STAR is an acronym for Strength, Testing, Analysis and Recording. The STAR car has a split axle that applies a 10,000 pound lateral load to both rail heads.

⁹ Gage requirements are found in 49CFR213.53.



Figure 2, view from BNSF #87 geometry car rear traveling west

On 10/27/2014 the STAR car identified two tight gage locations in the vicinity of the POD measuring 9/16 of an inch for a length of 9 feet at MP 596.69, and 5/16 of an inch for a length of 12 feet at MP 596.72. However, BNSF field personnel did not receive the above two STAR car defects as red tag defects as they were deleted by the STAR car operator immediately after detection due to a spike in the laser.

Herzog rail defect detection cars examine the rail for internal defects on a quarterly schedule¹⁰. The last rail inspection was conducted on 07/09/2015. The nearest rail defects were located at MP 596.268 (about 0.4 miles east of the POD). The previous examination of the rail for internal defects was on 04/22/2015.

The last DOT FRA track inspection was conducted on July 30, 2015 between the limits of MP 617.1 (Parkston, South Dakota) and MP 591.9 (Lesterville). The track inspector noted the following six track defects:

- Two center cracked joint bars located at MP 616.4 and MP 615.5
- Failure to comply with BNSF's CWR anchor procedures by not having a switch properly anchored at MP 616.4
- Two instances of less the two track bolts per rail end at MP 612.7 and at MP 602.7
- Loose or missing guardrail bolts on a switch located at MP 609.0

Bridge Description and Inspections

The bridge was photographed during an Osmoses bridge inspection on September 24, 2013. See Figure 3 for a depiction of bridge #596.7. The following is a description for bridge #596.7:

¹⁰ Typically a second rail inspection is conducted in the fourth quarter so five rail inspections for internal defects are conducted annually.

- Milepost: 596.7 at bent #1
- Aberdeen Sub-Division: (LS 2001)
- Description: Open Deck Timber Pile Trestle (OPT)
- Number of Spans: 7
- Span Length: 16 feet
- Overall Length: 111 feet
- Bridge Height: 26 feet
- Bridge Intersects: Prairie Creek
- Year Built: 1954
- Grade: Bridge 0.00 (level)
- Curvature: None; tangent track
- Every third bridge timber is anchored to the bridge stringers with boat spikes. The rail anchors are attached to the rail where the bridge timbers are attached to the stringers
- Timetable Speed was 25 mph and a 10 mph speed restriction for track surface conditions encompassed the bridge structure
- Cooper Load Rating: Normal E-60. Max Rating @ 10mph E-76 (See attachment 1 for a general description of Cooper Load Rating)
- Contracted Inspection: Osmose, 9/24/2013
- Last routine inspection: 3/23/2015 by BNSF Bridge Inspector
- Last routine inspection exception documented: Cap #1, decayed/crack. Priority level: "Maintenance" as scheduled
- Last routine inspection exception closed/repared: Cap #2 replaced
- A routine, a comprehensive, and a supervised inspection are required:
 - Supervised is once per calendar year; last conducted on 11/06/2014
 - Comprehensive is once per calendar year not exceeding 510 days since last comprehensive inspection; last conducted on 11/06/2014
 - Routine is in addition to supervised and comprehensive not to exceed 180 days since last inspection.



Figure 3
Bridge 596.7

Post-Accident Bridge Inspection

The bridge was destroyed from the ensuing fire. Therefore, bridge inspection reports and open exceptions had to be reviewed to determine the bridge integrity. Exception "ID"

number 4232161050914652 showed that the east end slope is eroded with the comment “east end worst condition” with comments from train crew. Additional comments showed install wing walls, ties hanging off bridge ends and have track lined and surfaced. The bridge inspector originally entered in the data base on 04/15/2009 as a maintenance priority; then on 01/31/2013, the priority was lowered to maintenance, and the work is still open to be completed.

Exception ID number 0906131061514652 showed that substructure #1 [bent 1] the cap is decayed and cracked. The priority level is maintenance. The bridge inspector entered the exception in the data base on 03/23/2015.

The BNSF bridge inspector said that after bridge cap #2 was replaced no track surfacing work was conducted east of bridge cap #1. He said it was the track departments’ job to surface the track off the bridge. The Roadmaster said that he did not know that the bridge cap had been replaced.

Postaccident Rail Recovery

The footprint of the derailment and the overhead picture gave a possible location of rail pieces. The rail segments recovered were placed in the order as they were prior to the derailment. This was accomplished by matching fractures faces and rail manufacturer stampings. The wheel drop off on the north rail and wheel strike marks on the joint bar continued leaving wheel marks leading to the lead truck of the first car to derail [CBTX 716019]. Across from the wheel drop off location were two pieces of rail buried in the ballast [piece 2 & 1] and were identified at the POD. Two matching pieces [3 & 4] were found on the southeast bridge approach embankment. See attachment 2, sketch of all the recovered rails¹¹. All 4 recovered rails, shown in figure 4, from the south side and the 1 rail from the north side were tagged with evidence tags and sent to the NTSB laboratory for further examination.

The POD is about 10 feet east of the east bridge abutment. The POD location was determined between rail pieces #2 and #3 at GPS location 43.088584 latitude and -97.676768 longitude, or milepost (MP) 596.66. See figure 4 for a depiction of recovered broken rail with fracture faces matched.

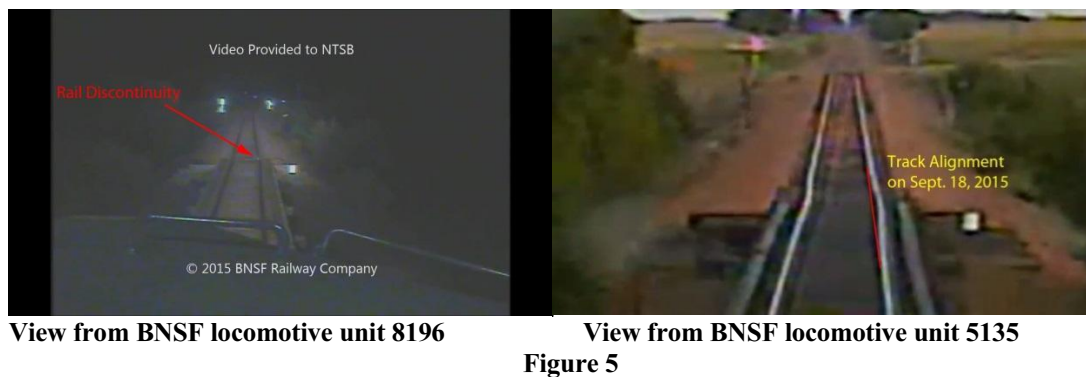


Figure 4
View of the recovered south rail segments from the area of the POD

The approximate location of the POD and track alignment was verified by images recorded by the head-end videos of the two previous trains. In figure 5, BNSF train G MNSDPK7 17 with head-end video from BNSF 8196 recording near the POD at 10:37 p.m. on September 18, 2015, and BNSF train X CNBMNS9 20 with head-end video from BNSF 5135

¹¹ The entire rail segments from the north side of the track was recovered, and all but 18 inches of the south rail was recovered.

recording near the POD at 4:07 p.m. on September 18, 2015. The train that derailed also had images recorded by the head-end video, but it was too foggy to discern any track anomalies.



At the POD the south rail brand read “9020 Illinois Steel Co South Wks VI 1909” on the gage side of the rail web. No heat stamp markings were observed on the field side of the web. According to the BNSF’s General Director Rail, track geometry cars inspecting BNSF track with 90-pound rail sections are set to generate “red tag wear notifications” at 0.5 inch vertical head loss and at 0.5 inch horizontal (gage face) wear. New 90-pound rail with section number 9020 manufactured by Illinois Steel had a rail height of 5.625 inches and a head width of 2.563 inches with a side slope of 1/16 to 1. The largest measured vertical rail head wear from the four south rail pieces was 0.237 inches and the largest gage face wear was 0.209 inches.

The mating fractures at the east end of piece 4S and the west end of piece 3S were examined. The fracture plane changed through the height of the rail where the fracture in the head was east of the fracture through the base with a curved shape within the web. The fracture faces were mostly obliterated by friction batter.¹² Some radial features visible in the base of the rail indicated fracture propagation emanating downward from the web. Head checks intersected the fracture surface up to 1/16 inch below the running surface. Trailing batter was observed on the running surface adjacent to the fracture on piece 4S.¹³ At the running surface of the mating fracture surface on piece 3S, a raised lip was observed adjacent to the fracture face consistent with deformation associated with the friction batter as the rail face on piece 3S moved downward relative to the fracture face on piece 4S. No fracture features were found on the battered faces to identify the fracture mechanism at the fracture origin.

The mating fractures at the east end of piece 3S and the west end of piece 2S were examined. The fracture occurred in essentially a flat transverse plane. Fracture features were largely obliterated by friction batter, and the fracture faces generally showed a blue-black tint. Spalls intersecting the fracture surfaces were observed at the gage side of the running surface adjacent to each of the fracture faces. The spall on piece 3S was approximately 1 inch wide, 1 ¼ inches long, and 1/8 inch deep. On piece 2S, the spall intersecting the fracture surface was approximately ½ inch wide, ¼ inch long, and ¼ inch deep. No fracture features were identified on the battered surfaces to indicate fracture propagation directions or fracture mechanism. See figure 6 for a depiction of the mating surfaces of rail pieces 2S and 3S. See the Materials Laboratory Factual report for the complete details of the rail examination.

¹² Friction batter is in-service rubbing due to relative motion between mating rail fracture surfaces.

¹³ Trailing batter is deformation at the vertical face of the delivering rail end. It can occur when a misalignment or gap between the two rails allows the wheel to drop below the surface of the delivering rail.



Figure 6 View of the west end of 2S



View of the east end of 3S

FRA train accident data shows that in the year 2015 there were eight derailments, or 22.2 percent of the total 36 derailments, caused by detail fracture rail defects.¹⁴ The data also showed that between January 2010 and December 2105 there were 92 derailments, or 22.8 percent of the total 404 derailments, caused by detail fracture rail defects.

Using the same data source, in the year 2015 there were two derailments, or 5.6 percent or the total 36 derailments, caused by worn rail. In addition, between January 2010 and December 2015 there were 10 derailments, or 2.5 percent of the total 404 derailments, caused by worn rail.

Post-Accident Track & Rail Inspection & Inspection Records Review

The DOT FRA track inspector reviewed the BNSF track inspection records for the track segment between MP 595.7 to MP 597.7 for the period beginning September 19, 2014 through September 19, 2015. The required inspection frequency is once per week and twice (during the week of October 26, 2014 thru November 1, 2014 and during the week of December 28, 2014 thru January 3, 2015) the inspection frequency was not met, although the track inspector did traverse the track both of these two weeks. The FRA also noted that on July 8, 2015 work was done on a rail joint (less than two track bolts per rail end) located at MP 596.7.

During the track group's investigation on September 19, 2015 between MP 596.65 and MP 598.7, railhead breakout was found on the north rail at MP 596.65 (about 250 feet east of the POD). Also at MP 596.68 there was a shelled, spalled, and corrugated (SSC) area that had been marked by a BNSF rail defect detector operator in 2013.¹⁵ At some point this SSC developed a 6 inch vertical split head on the field side of the rail head. With the 10 mph speed restriction that was already in place, this defect is compliant with the FRA *Track Safety Standards* Part 213.113, and can stay in track. However, the BNSF removed the rail defect and sectioned it. See figure 7, and note that the crack did not propagate through the entire rail head.

¹⁴ The parameters for derailments were set for; main tracks, for all railroads, for all states and regions, and cause code T-rail, joint bars, and rail anchoring.

¹⁵ *BNSF Engineering Instructions* 6.7.3 describes that a SSC (Type 24 BNSF defect code) are imperfections or deformations at or near the rail surface that may interfere with a valid search for internal defects.

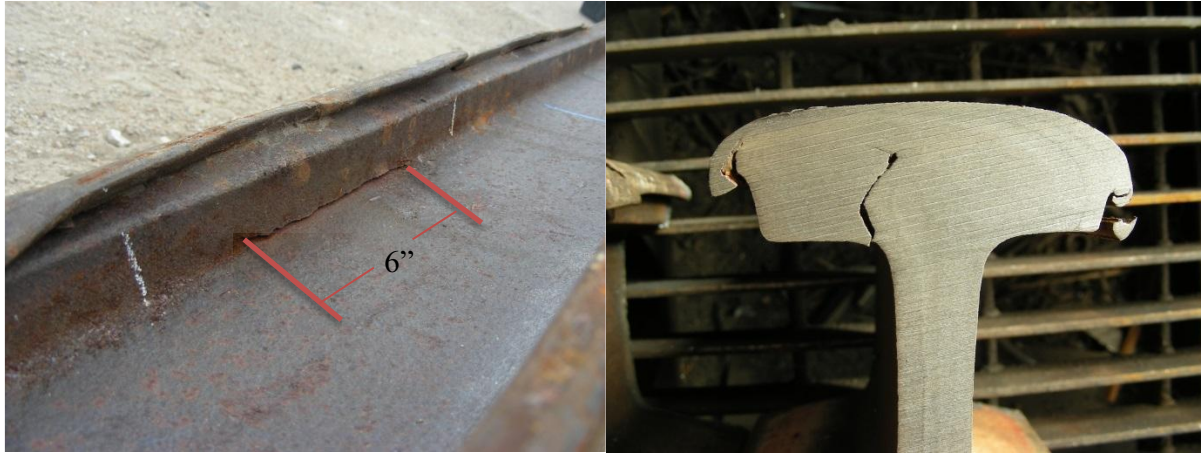


Figure 7

View of the crack under the ball of the rail and a cross-section view after the rail was sawed

Using the same FRA data source there were three derailments, or 8.3 percent of the total 36 derailments, caused by vertical split rail heads in 2015. In addition, between January 2010 and December 2015 there were 53 derailments, or 13.1 percent of the total 404 derailments, caused by vertical split rail heads.

The DOT FRA track inspector and the BNSF conducted a track inspection on September 20, 2015 between MP 595.2 and MP 599.8. The inspection team found the following track defects:

- At MP 597.5, and at MP 599.5 insufficient fasteners at a rail joint
- At MP 590.02 a culvert was separated and partially plugged
- At MP 599.07 a culvert was 40 percent silted shut on the North end
- At MP 598.8, at MP 599.3, and at MP 599.4 a wrong sized joint bar was installed
- At MP 598.85 loose joint bars
- At MP 595.3 center cracked joint bar

The FRA DOT track inspector also commented that at MP 595.5, and at MP 595.2, a SSC had been marked by a BNSF rail defect detector operator and at some point this SSC developed a 96 inch vertical split head and a 72 inch vertical split head defect respectively. Again, with the 10 mph speed restriction that was already in place, this defect is compliant with the FRA Track Safety Standards Part 213.113 for any size of a vertical split head as long as it did not break out into the rail head. Two other locations were found that were not marked with SSC, but had rail defects. A 13 inch horizontal split head at MP 596.6, and a 60 inch vertical split head was found at MP 595.2. Again with the 10 mph speed restriction that is already in place, these defects were compliant with the FRA Track Safety Standards Part 213.113.

The FRA DOT track inspector also commented that the both rails were moving about 3 ½ inches back and forth because the anchors were not against the ties and at the joint area the ties were skewed. There are no regulations in Part 213 that address rail anchors for jointed rails. As the ties skewed; the rail was pulled into the gage to create a tight gage measurement and a lateral rail misalignment.

The BNSF General Director of Rail said it was BNSF's internal requirements for remedial actions for vertical split heads, essentially for longitudinal defect, such as a vertical split head less than four inches, to require immediate restriction to ten miles per hour. In the case of

vertical split heads that are four inches in length or greater, the BNSF requires immediate restriction of ten-mile an hour, in addition, the BNSF requires removal of that track from service after 30 days from the day of detection if the defect is not removed. However, none of the vertical split heads were identified by either the BNSF track inspector or Roadmaster, or by the Herzog rail inspection vehicle operator, or by the previous FRA DOT track inspector.

Herzog representatives and the Party's track and engineering representatives met at the NTSB headquarters to review the rail defect detector car data. Herzog truck #169 was used to inspect the rails on 04/22/2015 and no defect indications were recorded at the POD. At the location of the SSC there was a loss of signal, but not enough to activate an alarm. The same inspection vehicle was used to inspect the rails on 07/09/2015. Again there were no indications of a rail defect at the POD. However, the loss of signal was more pronounced at the SSC, but again not enough to activate an alarm. The data also showed that the inspection vehicle was stopped and the rail at the SSC was visually inspected.

Damage Estimates

Track Department = \$58,000.

Bridge = \$325,000.00

END OF REPORT

Coopers Loading System

Cooper is responsible for developing in 1894, a system of calculations and standards for the safe loading of railway (railroad) bridges. Cooper's loading system was based on a standard of E10, meaning a pair of 2-8-0 type steam locomotives, pulling an infinite number of rail cars. Each locomotive was given an axle loading of 10,000 pounds (4,536 kg) for the driving axles, 5,000 pounds (2,268 kg) for the leading truck, and 6,500 pounds (2,948 kg) for the tender trucks. Each trailing rail car was given an axle loading of 1,000 pounds per foot (1,488 kg/m) of track. During the 1880s, railway bridges were built using an equivalent rating of E20. By 1894, when Cooper presented his standard, he recommended a standard of E40, or four times the E10 standard. By 1914, the standard had increased to E60. By the mid-1990s, the American Railway Engineering Association (AREMA) was recommending E72 (7.2 times the E10 standard) for concrete structures, and E80 for steel structures.

AREMA Cooper E-80 Loading

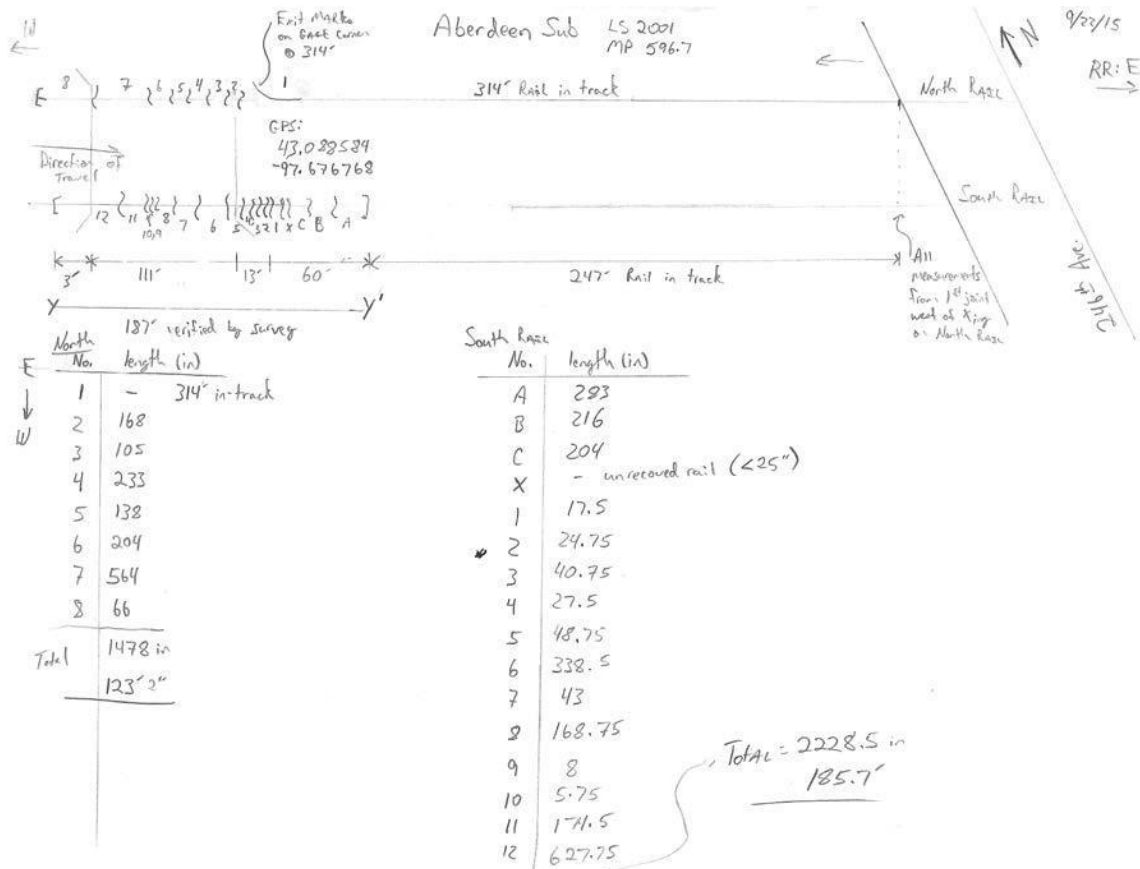
This loading is the standard AREMA load condition for which all railroad bridges nationwide are judged. Normal and Maximum Ratings shall be calculated for the Cooper E-80 loading shown below. Rating values shall be expressed as the equivalent E value compared to a single axle load of 80 kips (E-80).

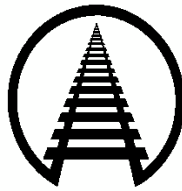
Normal Rating

Normal Rating is the load level that can be carried by the structure for its expected service life. Normal ratings shall be calculated and reported in accordance with the requirements of AREMA for each live load case with and without fatigue considerations. For bridges which have load ratings below normal limits listed in Sections 3.2.1, additional rating computations shall be performed using reduced operating speeds at 10-mile-per-hour increments between 60 mph and 10 mph. The rating engineer is not required to continue the reduced speed progression once the normal rating limit is achieved. The results of the reduced speed ratings shall be reported in the breakdown of bridge rating summary table. The procedures for incorporating speed reductions shall follow the latest edition of the AREMA Manual for Railway Engineering bridge rating guidelines. If fatigue governs the bridge load rating, and the rating is below the normal limit, the engineer may be required by the authority to calculate the remaining fatigue life of the structure.

Maximum Rating

Maximum Rating is the load level that the structure can support at infrequent intervals, with any applicable speed restrictions. Maximum ratings shall be calculated and reported in accordance with the requirements of AREMA for each live load case. For bridges which have been evaluated for Normal load ratings at reduced speeds, additional Maximum rating computations shall be performed for the corresponding speeds. The results of the reduced speed ratings shall be reported in the breakdown of bridge rating summary table.





ASSOCIATION OF AMERICAN RAILROADS

Robert C. VanderClute
Senior Vice President
Safety and Operations

CIRCULAR NO. OT-55-N

Effective August 5, 2013

(CPC-1258)

SUBJECT: Recommended Railroad Operating Practices for Transportation of Hazardous Materials

TO MEMBERS AND PRIVATE CAR OWNERS:

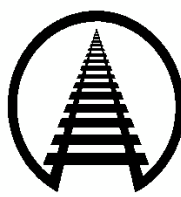
OT-55 has been revised as reflected below. OT-55-N (attached) becomes effective August 5, 2013 and supersedes OT-55-M, issued October 1, 2012. It is understood that it will take some time to implement changes reflected in the revised OT-55-N.

Changes include:

- I. A. - Definition of a “key train”
 - 1st bullet – Changed from “five tank car loads” to now read “one tank car load”. Also deleted Footnote 2 that was found after “ammonia solutions (UN3318).
 - 2nd bullet – will now read “20 car loads or portable tank loads of any combination of hazardous material.”
- IX – Applicability
 - Changed to read - These recommendations apply to rail operations within the United States of America.
- Eliminated Appendixes A, B and C (since any combination of hazardous materials are included). Remaining appendixes are now referenced as Appendixes 1,2 and 3.

Sincerely,

425 Third Street, SW, Suite 1000 | Washington, DC 20024 | O (202) 639-2200
rvanderclute@aar.org



Association of American Railroads

Circular OT-55-N Effective August 5, 2013

Recommended Railroad Operating Practices For Transportation of Hazardous Materials

**I. "Key Trains"
Road Operating Practices**

- A. Definition: A "Key Train" is any train with:
- One tank car load of Poison or Toxic Inhalation Hazard¹ (PIH or TIH) (Hazard Zone A, B, C, or D), anhydrous ammonia (UN1005), or ammonia solutions (UN3318),
 - 20 car loads or intermodal portable tank loads of any combination of hazardous material.
 - One or more car loads of Spent Nuclear Fuel (SNF), High Level Radioactive Waste (HLRW)

Appendix 1 is a list of SNF and HLRW with 49 Hazmat Codes, Appendix 2 is a list of time sensitive materials and Appendix 3 is a form for requesting hazardous materials commodity flow information.

- B. Restrictions:
1. Maximum speed -- "Key Train" - 50 MPH
 2. Unless siding or auxiliary track meets FRA Class 2 standards, a Key Train will hold main track at meeting or passing points, when practicable.
 3. Only cars equipped with roller bearings will be allowed in a Key Train.
 4. If a defect in a "Key Train" bearing is reported by a wayside detector, but a visual inspection fails to confirm evidence of a defect, the train will not exceed 30 MPH until it has passed over the next wayside detector or delivered to a terminal for a mechanical inspection. If the same car again sets off the next detector or is found to be defective, it must be set out from the train.

II. Designation of "Key Routes"

A. Definition: Any track with a combination of 10,000 car loads or intermodal portable tank loads of hazardous materials, or a combination of 4,000 car loadings of PIH or TIH (Hazard zone A, B, C, or D), anhydrous ammonia, flammable gas, Class 1.1 or 1.2 explosives, environmentally sensitive chemicals, Spent Nuclear Fuel (SNF), and High Level Radioactive Waste (HLRW) over a period of one year.

- B. Requirements:

¹ Poison Inhalation Hazard (PIH) and Toxic Inhalation Hazard (TIH) are used interchangeably and refer to the same list of chemicals.

1. Wayside defective bearing detectors shall be placed at a maximum of 40 miles apart on "Key Routes", or equivalent level of protection may be installed based on improvements in technology.
2. Main Track on "Key Routes" is inspected by rail defect detection and track geometry inspection cars or any equivalent level of inspection no less than two times each year; sidings are similarly inspected no less than one time each year; and main track and sidings will have periodic track inspections that will identify cracks or breaks in joint bars.
3. Any track used for meeting and passing "Key Trains" must be Class 2 or higher. If a meet or pass must occur on less than Class 2 track due to an emergency, one of the trains must be stopped before the other train passes.

III. **Yard Operating Practices**

- A. Maximum reasonable efforts will be made to achieve coupling of loaded placarded tank cars at speeds not to exceed 4 MPH.
- B. Loaded placarded tank cars of PIH or TIH (Hazard zone A, B, C or D), anhydrous ammonia, or flammable gas which are cut off in motion for coupling must be handled in not more than 2-car cuts; and cars cut off in motion to be coupled directly to a loaded placarded tank car of PIH or TIH (Hazard zone A, B, C, or D), anhydrous ammonia, or flammable gas must also be handled in not more than 2-car cuts.

IV. **Storage**

Separation Distance for New Facilities

Loaded Tank Cars and Storage Tanks from Mainline Class 2 Track or Higher

Activity	PIH (Zone A, B, C or D), Class 3, Division 2.1, Division 2.2 and all other Hazard Classes	Combustible Liquids, Class 8, and Class 9
Loading and Unloading	100 FEET	50 FEET
Storage of Loaded Tank Cars	50 FEET	25 FEET
Storage in Tanks	100 FEET	50 FEET

Note 1— With regard to existing facilities, maximum reasonable effort should be made to conform to this standard taking into consideration cost, physical and legal constraints. New facilities should take into consideration location of Mainline Class 2 Track or higher of all carriers.

Note 2— The proposals apply to storage on railroad property and on chemical company property located close to railroad mainline.

Note 3— These separations are primarily intended to provide protection to new facilities from main line derailments. Separation distances were derived from AAR derailment data for distances that cars typically travel from the main line during derailments. Although incidents that may occur in the new facilities cannot be quantified in the same manner, these separation distances will also provide some measure of protection to main line traffic. Also, both track class (e.g. operational speed) and hazard classification (e.g. risk) are factors that were taken into consideration when assigning the categories.

Note 4— Distances above are measured from track centerline to track centerline or from track centerline to nearest edge of storage tanks.

V. **TRANSCAER®** (Transportation Community Awareness and Emergency Response Implementation of Transcaer®)

Railroads will assist in implementing TRANSCAER®, a system-wide community outreach program to improve community awareness, emergency planning and incident response for the transportation of hazardous materials. Objectives of TRANSCAER® are as follows:

- Demonstrate the continuing commitment of chemical manufacturers and transporters to the safe transportation of hazardous materials;
- Improve the relationship between manufacturers, carriers and local officials of communities through which hazardous materials are transported;
- When requested assist Local Emergency Planning Committees (LEPC's) in assessing the hazardous materials moving through their communities and the safeguards that are in place to protect against unintentional releases. Upon written request, AAR members will provide bona fide emergency response agencies or planning groups with specific commodity flow information covering at a minimum the top 25 hazardous commodities transported through the community in rank order. The request must be made using the form included as Appendix 3 by an official emergency response or planning group with a cover letter on appropriate letterhead bearing an authorized signature. The form reflects the fact that the railroad industry considers this information to be restricted information of a security sensitive nature and that the recipient of the information must agree to release the information only to bona fide emergency response planning and response organizations and not distribute the information publicly in whole or in part without the individual railroad's express written permission. It should be noted that commercial requirements change over time, and it is possible that a hazardous materials transported tomorrow might not be included in the specific commodity flow information provided upon request, since that information was not available at the time the list was provided;
- Assist LEPC's in developing emergency plans to cope with hazardous materials transportation incidents;
- Assist community response organizations in preparations for responding to hazardous materials incidents.

An important product of the TRANSCAER® program will be to overcome the widespread belief that every local firefighter and policeman must have the expert skills and equipment to respond personally to any hazardous materials emergency. Through the awareness training and contingency planning provided through TRANSCAER®, states and local communities will be able to pool their expertise and resources with those of industry to provide for a more coordinated and better managed emergency response system.

TRANSCAER® should be highly publicized to produce the maximum desirable enhancement of public awareness.

VI. Criteria for Shipper Notification

The railroads will initiate the shipper's emergency response system by calling CHEMTREC, or the appropriate contact telephone number as required by regulation on the shipping document, when an incident occurs involving any car (load or residue) containing a hazardous material regulated in transportation by the Department of Transportation.

An incident is defined as a rail car which is derailed and not upright, or which has sustained body or tank shell damage, or has sustained a release of any amount of product.

The shipper's emergency response system should also be initiated if the carrier believes there is reason to suspect any other potential for injury to people, property or the environment.

In the event of a major rail accident, a consist (to include shipper, consignee and commodity description for each hazardous material), waybill or equivalent document, should be provided upon request to CHEMTREC or the appropriate shipper contact as identified by the emergency response telephone number displayed on the shipping document. This can be accomplished by facsimile or other appropriate and acceptable electronic means.

A major rail accident is defined as one resulting in fire, explosion, the potential for an explosion, fatalities, evacuation of the general public, or multiple releases of hazardous materials.

Anytime a consist or other document is provided to CHEMTREC or the appropriate contact a follow-up call by the carrier should be made to confirm the receipt of the information as well as to provide other additional information pertaining to the incident not contained in the facsimile or electronically transmitted document.

This practice does not preclude any carrier from notifying CHEMTREC or the appropriate shipper contact of a rail incident involving hazardous materials that does not meet the criteria outlined above.

VII Time Sensitive Materials

Railroads and shippers will be responsible for monitoring the shipments (loads & residue) of products classified by the Department of Transportation as being time sensitive.

This monitoring process will, at a minimum, provide a means to ensure the movement of rail cars containing time sensitive materials (for list see Appendix 2) in order to achieve delivery of the product within the time specified by the Department of Transportation.

As warranted, railroads will implement an internal escalation process and communicate with shippers, receivers and other rail carriers concerning any rail car containing a time sensitive product that has been delayed in transit to the extent that it may not reach destination within the time specified by the Department of Transportation. In such cases, an expedited movement of the rail car, or other action as deemed appropriate by the carrier and shipper will be taken.

VIII Special Provision for Spent Nuclear Fuel (SNF) and High Level Radioactive Waste (HLRW)

When a train carrying SNF or HLRW meets another train carrying loaded tank cars of flammable gas, flammable liquids or combustible liquids in a single bore double track tunnel, one train shall stop outside the tunnel until the other train is completely through the tunnel.

IX Applicability

These recommendations apply to rail operations within the United States of America.

(Supersedes Circular No. OT-55-M dated October 1, 2012)

Issued by:

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Appendix 1
Spent Nuclear Fuel (SNF) and High Level Radioactive Waste (HLRW)
August 5, 2013

HMRC	Proper Shipping Description
4929142	Radioactive Material, Type B(U) Package, Fissile
4929143	Radioactive Material, Type B(M) Package, Fissile
4929144	Radioactive Material, Transported Under Special Arrangement, Fissile
4929147	Radioactive Material, Transported Under Special Arrangement

Appendix 2
Time Sensitive Materials
August 5, 2013

Proper Shipping Name	Haz Mat STCC
20 Day	
Ethylene, refrigerated liquid	4905735
Hydrogen, refrigerated liquid	4905745
Vinyl Fluoride, stabilized	4905793
Chloroprene, stabilized	4907223
Flammable Liquid, n.o.s. (Methyl Methacrylate Monomer, uninhibited)	4907255
Hydrogen chloride, refrigerated liquid	4920504
30 day	
Styrene monomer, stabilized	4907265
Styrene monomer, stabilized	4907235

Appendix 3
Sample Request for Hazardous
Materials Commodity Flow
Information August 5, 2013

[Company LOGO]

Request for Hazardous Materials COMMODITY FLOW
INFORMATION

Organization Requesting Information:

Contact Person:

Phone Number:

Email Address:

Mailing Address:

(Street Address)

(City, State, Zip)

Geographical Description of Area for study:

Preferred method to receive report: ☐ Email ☐ U.S. Mail (Mark One)

By signing below I acknowledge and agree to the terms set forth by **[RAILROAD NAME]** for use and dissemination of the

[RAILROAD'S] Hazardous Materials Commodity Flow Information. **[RAILROAD'S NAME]** considers this information to be restricted information of a security sensitive nature. I thus affirm and agree that the information provided by **[RAILROAD NAME]** in this report will be used solely for and by bona fide emergency planning and response organizations for the expressed purpose of emergency and contingency planning. This information will not be distributed publicly in whole or in part without the expressed written permission of **[RAILROAD NAME]**.

(Signature of person requesting commodity flow information)

Return Completed Form to: [INSERT RAILROAD NAME AND ADDRESS]

For [RAILROAD] Use Only

[PERSON RESPONSIBLE FOR APPROVAL]: ____Yes____NO Date:

Hazardous Materials Service Support:

Date Request Received:

Time Period Covered:

Date Report Sent:

Report sent via: ☐ Email ☐ U.S. Mail

Attachment 4

Hazardous Materials Regulations 49 CFR 172.820 stipulates additional planning requirements for transportation by rail.

a) *General.* Each rail carrier transporting in commerce one or more of the following materials is subject to the additional safety and security planning requirements of this section:

(1) More than 2,268 kg (5,000 lbs) in a single carload of a Division 1.1, 1.2 or 1.3 explosive;

(2) A quantity of a material poisonous by inhalation in a single bulk packaging;

(3) A highway route-controlled quantity of a Class 7 (radioactive) material, as defined in §173.403 of this subchapter; or

(4) A high-hazard flammable train (HHFT) as defined in §171.8 of this subchapter.

(b) Not later than 90 days after the end of each calendar year, a rail carrier must compile commodity data for the previous calendar year for the materials listed in paragraph (a) of this section. The following stipulations apply to data collected:

(1) Commodity data must be collected by route, a line segment or series of line segments as aggregated by the rail carrier. Within the rail carrier selected route, the commodity data must identify the geographic location of the route and the total number of shipments by UN identification number for the materials specified in paragraph (a) of this section.

(i) A rail carrier subject to additional planning requirements of this section based on paragraph (a)(4) of this section, must complete the initial process by March 31, 2016, using data for the six month period from July 1, 2015 to December 31, 2015; or

(ii) A rail carrier subject to additional planning requirements of this section based on paragraph (a)(4) of this section, must complete the initial process by March 31, 2016, using data for all of 2015, provided the rail carrier indicates in their initial analysis that it has chosen this option.

(2) A carrier may compile commodity data, by UN number, for all Class 7 materials transported (instead of only highway route controlled quantities of Class 7 materials) and for all Division 6.1 materials transported (instead of only Division 6.1 poison inhalation hazard materials).

(c) *Rail transportation route analysis.* For each calendar year, a rail carrier must analyze the safety and security risks for the transportation route(s), identified in the commodity data collected as required by paragraph (b) of this section. The route analysis must be in writing and include the factors contained in appendix D to this part, as applicable.

(1) The safety and security risks present must be analyzed for the route and railroad facilities along the route. For purposes of this section, railroad facilities are railroad property including, but not limited to, classification and switching yards, storage facilities, and non-private sidings. This term does not include an offeror's facility, private track, private siding, or consignee's facility.

(2) In performing the analysis required by this paragraph, the rail carrier must seek relevant information from state, local, and tribal officials, as appropriate, regarding security risks to high-consequence targets along or in proximity to the route(s) utilized. If a rail carrier is unable to acquire relevant information from state, local, or tribal officials, then it must document that in its analysis. For purposes of this section, a high-consequence target means a property, natural resource, location, area, or other target designated by the Secretary of Homeland Security that is a viable terrorist target of national significance, the attack of which by railroad could result in catastrophic loss of life, significant damage to national security or defense capabilities, or national economic harm.

(d) Alternative route analysis. (1) For each calendar year, a rail carrier must identify practicable alternative routes over which it has authority to operate, if an alternative exists, as an alternative route for each of the transportation routes analyzed in accordance with paragraph (c) of this section. The carrier must perform a safety and security risk assessment of the alternative routes for comparison to the route analysis prescribed in paragraph (c) of this section. The alternative route analysis must be in writing and **include the criteria in appendix D** of this part. When determining practicable alternative routes, the rail carrier must consider the use of interchange agreements with other rail carriers. The written alternative route analysis must also consider:

- (i) Safety and security risks presented by use of the alternative route(s);
- (ii) Comparison of the safety and security risks of the alternative(s) to the primary rail transportation route, including the risk of a catastrophic release from a shipment traveling along each route;
- (iii) Any remediation or mitigation measures implemented on the primary or alternative route(s); and
- (iv) Potential economic effects of using the alternative route(s), including but not limited to the economics of the commodity, route, and customer relationship.

(2) In performing the analysis required by this paragraph, the rail carrier should seek relevant information from state, local, and tribal officials, as appropriate, regarding security risks to high-consequence targets along or in proximity to the alternative routes. If a rail carrier determines that it is not appropriate to seek such relevant information, then it must explain its reasoning for that determination in its analysis.

(e) Route Selection. A carrier must use the analysis performed as required by paragraphs (c) and (d) of this section to select the route to be used in moving the materials covered by paragraph (a) of this section. The carrier must consider any remediation measures implemented on a route. Using this process, the carrier must at least annually review and **select the practicable route posing the least overall safety and security risk**. The rail carrier must retain in writing all route review and selection decision documentation and restrict the distribution, disclosure, and availability of information contained in the route analysis to covered persons with a need-to-know, as described in parts 15 and 1520 of this title. This documentation should include, but is not limited to, comparative analyses, charts, graphics or rail system maps.

(f) Completion of route analysis. (1) The rail transportation route analysis, alternative route analysis, and route selection process required under paragraphs (c), (d), and (e) of this section must be completed no later than the end of the calendar year following the year to which the analyses apply.

(2) The initial analysis and route selection determinations required under paragraphs (c), (d), and (e) of this section must include a comprehensive review of the entire system. Subsequent analyses and route selection determinations required under paragraphs (c), (d), and (e) of this section must include a comprehensive, system-wide review of all operational changes, infrastructure modifications, traffic adjustments, changes in the nature of high-consequence targets located along, or in proximity to, the route, and any other changes affecting the safety or security of the movements of the materials specified in paragraph (a) of this section that were implemented during the calendar year.

(3) A rail carrier need not perform a rail transportation route analysis, alternative route analysis, or route selection process for any hazardous material other than the materials specified in paragraph (a) of this section.

APPENDIX D TO PART 172—RAIL RISK ANALYSIS FACTORS, states in part:

Factors to be considered in the performance of this safety and security risk analysis include:

1. Volume of hazardous material transported;
2. Rail traffic density;
3. Trip length for route;
4. Presence and characteristics of railroad facilities;
5. Track type, class, and maintenance schedule;
6. Track grade and curvature;
7. Presence or absence of signals and train control systems along the route (“dark” versus signaled territory);
8. Presence or absence of wayside hazard detectors;
9. Number and types of grade crossings;
10. Single versus double track territory;
11. Frequency and location of track turnouts;
12. Proximity to iconic targets;
13. Environmentally sensitive or significant areas;
14. Population density along the route;
15. Venues along the route (stations, events, places of congregation);
16. Emergency response capability along the route;
17. Areas of high consequence along the route, including high consequence targets as defined in § 172.820(c);
18. Presence of passenger traffic along route (shared track);
19. Speed of train operations;
20. Proximity to en-route storage or repair facilities;
21. Known threats, including any non-public threat scenarios provided by the Department of Homeland Security or the Department of Transportation for carrier use in the development of the route assessment;
22. Measures in place to address apparent safety and security risks;
23. Availability of practicable alternative routes;
24. Past incidents;
25. Overall times in transit;
26. Training and skill level of crews; and
27. Impact on rail network traffic and congestion.